

Letters to the Editor

Distinguishing solid from gaseous emboli during cardiac surgery

To the Editor:

We read with interest the article by Abu-Omar and colleagues¹ regarding the use of a multifrequency Doppler system to identify solid and gaseous cerebral emboli during cardiac surgery. Although this system has been validated in two clinical situations, patients with carotid artery stenosis and those with mechanical heart valves, it has not however, been tested in large studies of patients undergoing cardiopulmonary bypass. As the authors of the original validation study point out, there are limitations of automatic cerebral emboli detection with the multifrequency Doppler system.² First, automatic detection and counting are unreliable in situations with a high frequency of emboli. This might not be a significant problem in the case of patients with mechanical valves or carotid artery stenosis, where the frequency of emboli generation is low, but certainly will be during cardiac surgery, where showers of emboli are frequently associated with clamp removal and rewarming. Second, highly echogenic particles—solid or gaseous—can generate high-intensity embolic signals, leading to receiver overload and aliasing. These particles would cause a bidirectional intensity increase and thus lead to mistaken identification of such embolic signals as artifact. Thus the number of embolic signals detected by Abu-Omar and colleagues¹ probably underestimates the true embolic burden, especially during the on-pump and open procedures. As a result there is a large difference between the emboli count detected during on-pump coronary artery bypass grafting with this study and that seen in other investigations that have used a Doppler machine that insonates a vessel with only one frequency.

We also note that the cardiopulmonary bypass technique did not involve use of an arterial filter and that cardiectomy suction was used without a cell saver. Arterial filters have been shown to significantly reduce the amount of cerebral embolization

and neurocognitive impairment, and if a cell saver is used to retrieve and process shed mediastinal blood, the microembolic burden is reduced relative to direct autotransfusion from cardiectomy suction.^{4,5} It is important that these methodologic deficiencies be taken into account if this cohort of patients is to undergo neurocognitive assessment.

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Reply to the Editor:

We thank Motallebzadeh and Jahangiri for their interest in our article.

The advantages of multirange, multifrequency transcranial Doppler technique are, respectively, rejection of artifacts and differentiation between gaseous and solid microemboli. This is of particular relevance because automatic rejection of artifacts significantly reduces bias in the interpretation

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TABLE 1. Variation in microembolic counts among different studies

Study	On-pump	Off-pump
Abu-Omar et al, 2004 ³	275	40
Motallebzadeh et al, 2004 ⁴	2016	16
Scarborough et al, 2003 ⁵	372	47
Lund et al, 2003 ⁶	90	16
Lee et al, 2003 ⁷	575	16
Mullges et al, 2003 ⁸	175, 413*	—
Bowles et al, 2001 ⁹	1766	27
Fearn et al, 2001 ¹	136	—
Diegeler et al, 2000 ¹⁰	395	11
Borger et al, 1999 ¹¹	152, 249†	—
Taylor et al, 1999 ¹²	207	—

*Different cannulation techniques. †Difference in cannulation site.

of high-intensity transient signals and avoids interobserver variability, whereas discrimination between solid and gaseous microemboli may have important pathophysiological, therapeutic, and prognostic implications.

The limitation of undercounting showers of microemboli (such as during removal of crossclamps and side clamps) was, in fact, discussed in our article. Although Motallebzadeh and Jahangiri suggest that this limitation may be responsible for a large difference in embolic count relative to previous reports, a review of the literature reveals that there is already wide variability among different studies (Table 1) because of differences in detection characteristics among various transcranial Doppler systems. Furthermore, the phenomenon of “undercounting” may actually serve to underestimate the benefits of off-pump surgery with a “no touch” aortic technique, where such showers are not seen.

At the time of our study, it was not our routine practice in Oxford to use arterial line filters. We now do so, although evidence for this is still not compelling. Others have reported an abundance of microemboli during cardiopulmonary bypass despite the use of 40- μ m arterial filtration,¹ and leukocyte-depleting arterial line filters have reportedly failed to improve neurocognitive outcome.² On the other hand, the use of a cell saver in place of cardiotomy suction can potentially reduce the number of lipid microemboli. Although a combination of these techniques is likely to reduce microembolization during cardiopulmo-

nary bypass, it is still unlikely to reach the levels seen in off-pump surgery with a “no touch” aortic technique.

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The answer is an intra-aortic balloon pump

To the Editor:

We have presented an article¹ in the *Journal* with a case of wrong anastomosis of the left internal thoracic artery (LITA) with the cardiac vein that could not be detected with transit flow measurement. The LITA graft anastomosed with the cardiac vein demonstrated biphasic and diastolic-dominant flow, forming a trapezoid-shaped waveform, which was quite similar to the flow of the patent LITA graft to the left coronary artery.

Readers may not be able to understand why the arteriovenous flow pattern was similar to the arterioarterial flow pattern in this patient, because we did not discuss the mechanism that caused this similarity. In addition, readers may think that this similarity in flow pattern between the arteriovenous graft and the arterioarterial graft supports the idea of selective arterialization of the coronary venous system for patients with severe diffuse coronary artery disease.²⁻⁴ More recently, this idea has been expanded to the concept of percutaneous in situ coronary venous arterialization.⁵

The answer for this is the use of the intra-aortic balloon pump (IABP) in our patient. We have been applying prophylactic and preincision IABP aggressively to patients undergoing coronary artery bypass grafting. The IABP-induced diastolic flow augmentation of the incorrect LITA graft may result in the trapezoid-shaped waveform in transit flow measurement. Unfortunately, we did not record the waveform of the graft without IABP counterpulsation in this patient. We need further investigation of the flow pattern of the graft to the